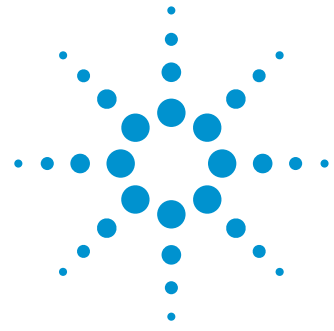


# Agilent 81150A and 81160A Pulse Function Arbitrary Noise Generators – Applications



Accurate Pulse, Function Arbitrary and Noise  
Generation in a Single Box

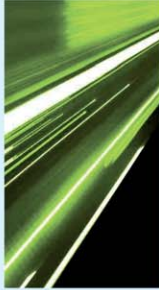




Version 1.1

- Noise and Jitter Tolerance Testing
- Noise Source for SATA
- Radar
- Nanotechnology



**Agilent Technologies**

# Introduction

Physical Layer					
Digital Displays	Memory	Computing I/O	Enterprise	Communications	Aerospace/Defense
Video	Consumer Computation	Chip-to-Chip Backplane	Storage LAN	Wireline Wireless	Sat/Comm
					

Device emulation, precise clock source, noise immunity testing, simulation customer design, DC brushless motors, sonar testing, modulator testing, component testing, mixed signal devices, trigger ...

The Agilent 81150A and 81160A pulse function arbitrary noise generators focus on engineers in manufacturing, R&D and education across the industry.

The new class of instrument combines three instruments in one:

- High precision **pulse generator** is enhanced with a versatile signal generator, offering distortion capabilities to stress your device to its limit.
- **Function arbitrary generator** provides versatile waveforms and modulation capabilities to adapt the signal to devices requirements.
- **Noise generator** combines two required extremes: random noise and repeatable noise with very long repetition rates for simple problem identification.

The versatile instrument is a must have for every lab as many different devices under test can be stimulated.

In addition, the 81150A and 81160A let you inject noise for testing serial bus standards.

Wherever precise, versatile signals and distortion capabilities are needed, the 81150A and 81160A are the instruments of choice.

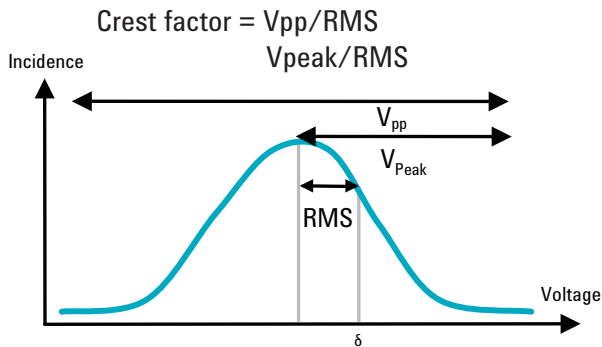
Both of them provide accurate and accelerated insight into your device through ideal and real-world signals. Just generate the signal you need – because just enough is not enough.

# Noise and Jitter Tolerance Testing

Jitter and noise cause misalignment of edges and levels, resulting in data errors. Noise is by its nature unpredictable because it can have many different causes, from signal interference caused by sudden voltage changes, to distortions introduced during transmission.

It is important to be able to simulate noise-based malfunctions, for example to identify the additive noise produced by receiving systems – it is cheaper to lower the noise figure than to increase the transmitter power. The 81150A and 81160A let you control the quality of the noise and test different cases according to various specifications.

Gaussian white noise is a good approximation of many real-world situations and creates mathematically traceable models, with statistically independent values.

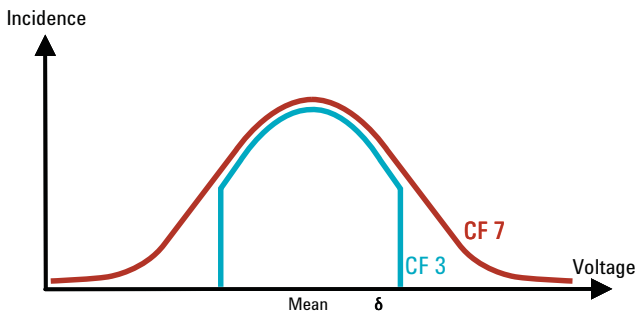


Crest factor definition

The crest factor is an indicator of signal quality. The higher the crest factor is, the more noise is used. The 81150A and 81160A provide four selectable crest factors using Vp/RMS or Vpp/RMS. The Vp/RMS definition is used by both instruments.

RX jitter tolerance tests conducted by a noise source with a low crest factor might let you pass the test even if the device is momentarily substandard.

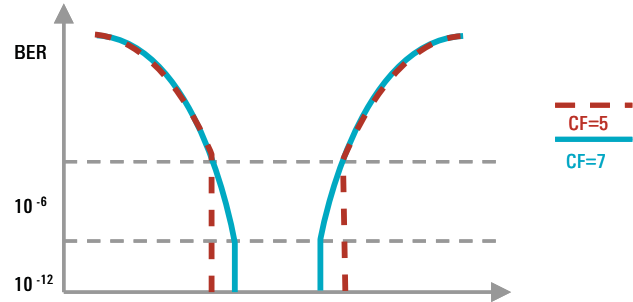
## Different crest factors



Gaussian curve of crest factor 3 and 7

The crest factor of seven corresponds to a BER  $10^{-23}$  which is required by the serial bus standards.

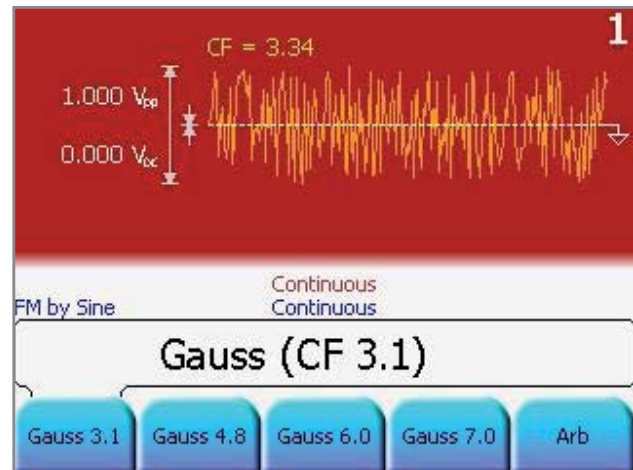
## BER and the different crest factors



Bath tub with different crest factors

The noise provided by the instruments is triggerable, and the signal repetition rate is 20 days for the 81160A and 26 days for the 81150A. This guarantees randomness and repeatability.

The 81150A and 81160A let you define any arbitrary distribution, which is ideal if you need your noise with a non-Gaussian distribution.



Agilent 81150A noise probability function screen

Both instruments provide deterministic white noise either with Gaussian or arbitrary distribution with a signal repetition rate of 20 to 26 days for the 81150A. You can trigger the noise to start when you need it and your results are repeatable.

## Noise Source for SATA

Serial ATA (SATA) is the next generation personal computer storage interface. SATA I operates at 1.5 Gb/s, SATA II at 3 Gb/s and SATA III at 6 Gb/s.

In order to perform receiver jitter tolerance testing on SATA transceivers, several pieces of equipment are needed.

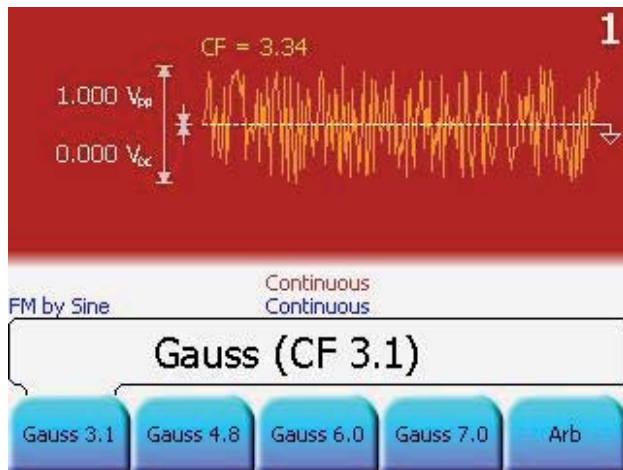
So far, an Agilent 33250A was needed for the sinusoidal jitter and a noise source for the random/deterministic jitter. The jitter is injected to the delay control in line of a pattern generator, which generates the signal with the appropriate frequency.

The 81150A and 81160A can generate both jitter types in one instrument, thus providing a cost effective solution as two instruments with a power divider are no longer required.

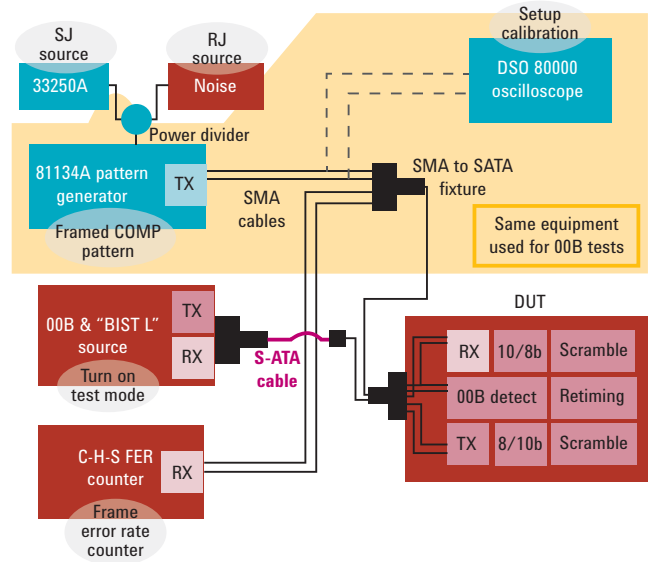
### Random jitter

The Agilent 81150A and 81160A pulse function arbitrary noise generators provide deterministic Gaussian white noise, with a signal repetition of 20 days for the 81160A and 26 days for the 81150A. You can decide on any arbitrary distribution and trigger the noise to start when you need it.

You can select the required crest factor of seven – using  $V_p/RMS$ . This crest factor corresponds to a BER  $10^{-12}$ .



Noise probability function screen



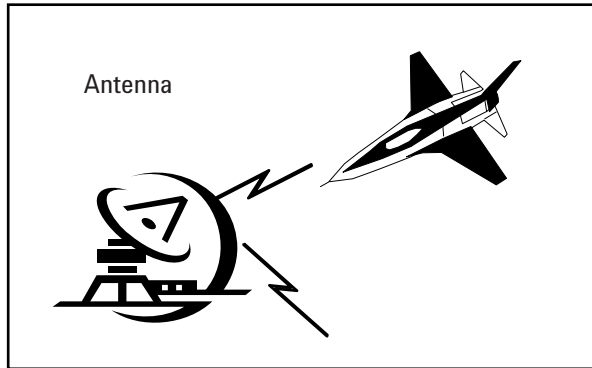
SATA receiver test set up

### Sinusoidal jitter

For the sinusoidal jitter select a sine wave and set the required frequency. Calibrate the jitter by adjusting the amplitude and observing the jitter on the jitter measurement device.

The 81150A and 81160A are integrated in the Agilent test automation software platform, N5990A Option 103. The software provides compliance and interoperability testing and fully controls the test setup including sinusoidal and random noise.

# Radar Communication Systems in the Aviation and Military Industries



Radar distance test to airborne planes

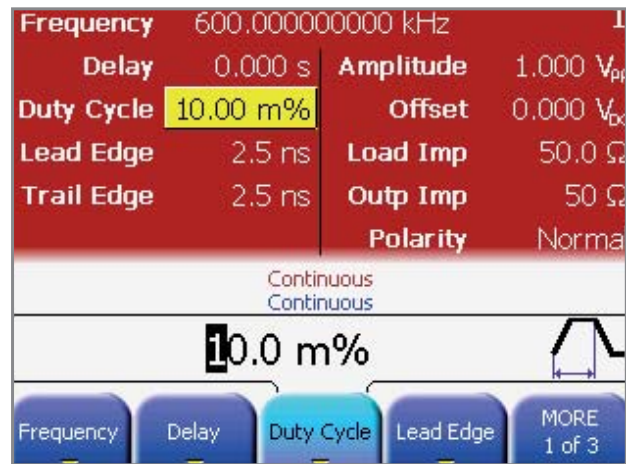
Agilent pulse generators are often used for testing radar communication systems in the military industry and the aviation industry. The application note, "Radar Distance Test to Airborne Planes" (5968-5843E), describes the usage of the 81110A.

To determine the distance of a target object e.g. an airborne plane, a triggered pulse train is sent from the control tower's radar system to an airborne plane. The plane responds with a standard signature which is sent back to the control tower. The tower receives the signal, recognizes the signature, and then analyzes the delay to determine the distance between the tower and the airborne plane.

Important functionality:

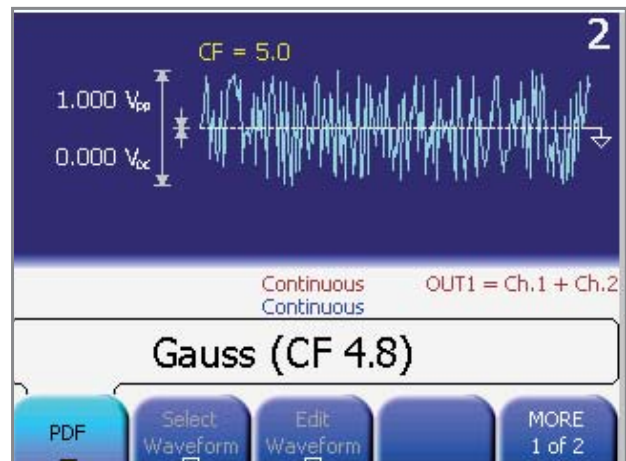
- rise / fall times 2.5 ns
- triggered pulse stream internally or via an external signal
- burst of pulse stream
- small duty cycles
- highest possible frequency accuracy

The 81150A and 81160A can be used to simulate the radar signal. Varying the delay from the external trigger to the start of the output signal can simulate various distances from the control tower.



Example settings channel 1

Besides the precise signal with accurate rise and fall times of 2.5 ns, a distortion of the signal is interesting.



Channel 2 with selected crest factor of 4.8

The crest factor is a sign of signal quality, the higher the crest factor the more complete – real world – noise is available. The channel add functionality can add the signal of channel two to channel one. So any modulation or noise with different crest factors can be added to the precise signal.

# Control the Amount of Energy for Nanotechnology Devices

Nanotechnology starts to gain importance in the semiconductor technologies through denser memory, faster processors and electronic devices that need less power. Engineers need to fully characterize devices and materials, which require:

- Small voltage
- Accurate and repeatable measurements

The measurement techniques and instruments require minimal noise and other sources of error that might interfere with the signal.

It is very important to control the amount of energy during the measurement, otherwise you damage the device under test.

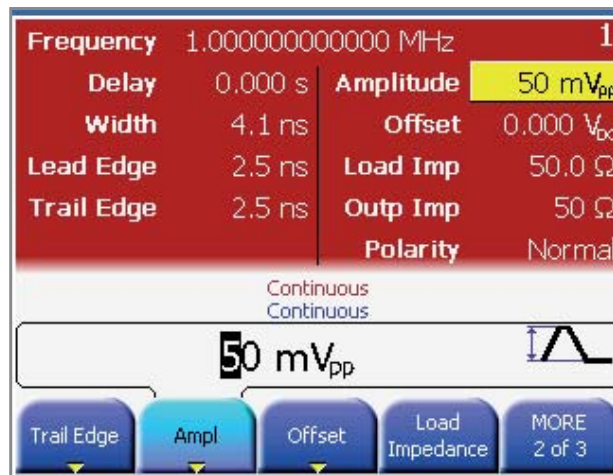
Short pulses and bursts of pulses are important to avoid heat generation. Small duty ratio allows the device under test to cool down and short pulse width avoids leakage through gate oxide.

The Agilent 81150A provides:

- Pulse width 4.16 ns to (period – 4.16 ns)
- Transition times 2.5 ns to 1000 s (10/90)
- Variable rise and fall time
- Differential output
- Pulse width modulation for real stress test

The Agilent 81160A:

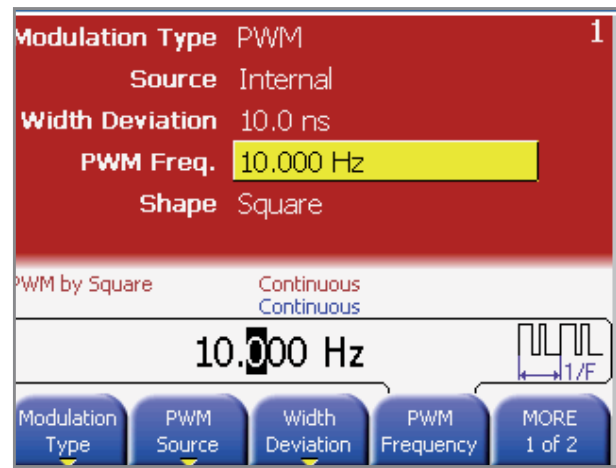
- Pulse width 1.50 ns (period - 1.50 ns)
- Transitions times 1.0 ns to 1000 s (10/90)
- Variable rise and fall time
- Differential output
- Pulse width modulation for real stress test



Setting up a pulse

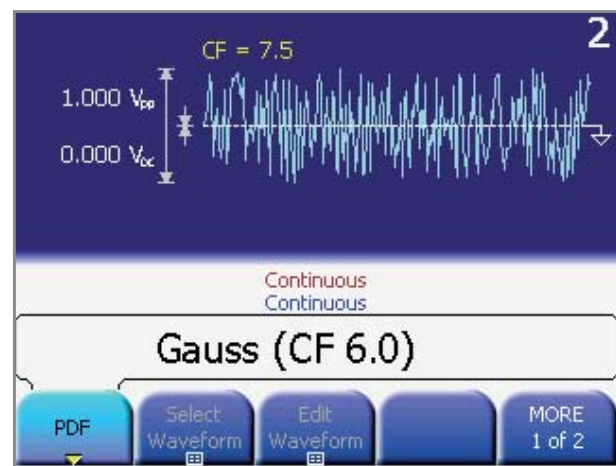
The 81150A and 81160A are pulse generators, an instrument typically used for this kind of measurements. They guarantee accurate and repeatable measurements.

The combination of the pulse and function arbitrary generator allow special stress tests like the pulse width modulation. The modulation of the duty cycle allows for control of the amount of power, which is critical for this type of device.



Setting up a pulse width modulation

The 81150A and 81160A include a noise generator as well. Through channel add, noise can be added to the pulse or pulse width modulated signal. By adding different amounts of noise you can stress your device to its limit.



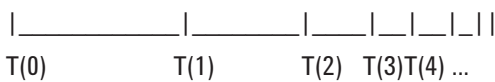
Setting up noise

# Signal Emulation for Nuclear Power Stations

Simulation solutions for reactor stability testing are very sensitive. It is extremely important that the monitoring system is well tested and fault events generate an alarm.

When barium sticks are pulling out, pulse quantity increases exponentially. The verification of the alarm and monitoring system requires generators to simulate an exponential increase of pulse frequency whereby the pulse duration has to be consistent.

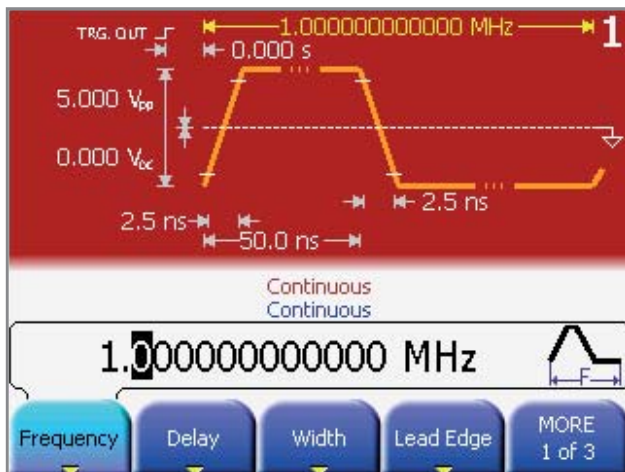
Required signal:



$T(n)$  must vary in exponential law. Pulse duration should be constant. Period between pulses is exponential.

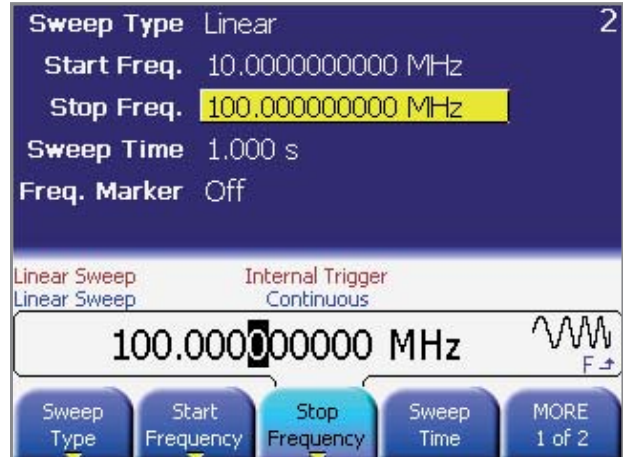
Previously, both a pulse generator and an arbitrary generator were needed for this application, however, the 81150A and 81160A combine an Agilent proven pulse generator and a function arbitrary generator, meaning only one instrument is needed.

The first channel provides the pulses.



*Pulse generator configuration screen*

The second channel provides a frequency sweep and triggers the first channel.



*Frequency sweep configuration screen*

The 81150A and 81160A allow the reduction from two to one instrument which corresponds with higher test efficiency.

For this application the two channel version is needed. The channels can work entirely independently as required with this application, but the channels can be coupled with a defined delay as well.

Related Literature	Pub. No.
<i>Agilent 81150A and 81160A Pulse Function Arbitrary Noise Generators Data Sheet</i>	5989-6433EN
<i>Agilent 81150A and 81160A Pulse Function Arbitrary Noise Generators Demo Guide</i>	5989-7718EN
<i>Agilent 81150A Pulse Function Arbitrary Noise Generator Flyer</i>	5989-7720EN
<i>Agilent 81160A Pulse Function Arbitrary Noise Generator Quick Fact Sheet</i>	5990-6984EN
<i>Pulse Pattern and Data Generator Brochure</i>	5980-0489E

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